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A REAL TIME METHOD FOR FOURIER TRANSFORM HOLOGRAPHIC INFORMATION STORAGE

by

Cai Tiequan, Wan Hui, Tian Zhiwei

HUMAN TRANSLATION

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An experiment was designed as it was shown in fig.1. S is white light source and is recorded as $O(x_0,y_0)$. LCLV is a light crystal light valve in mixed field effect. Lens L_1 forms image I(x,y) on CdS membrane of a light conducting layer of light valve.When voltage on liquid crystal layer > threshold of liquid crystal, a voltage image can be formed on CdS and liquid crystal which corresponds to input light image. Laser LA is subdivided into two beams on BS_1. One beam is used as reference light, the other beam is scattered by K and is condensed by L_2, and then is refracted by P_1. Subsequently it is reflected by BS_2 and forms parallel beams. They are then reflected by LCLV and controlled by voltage on the liquid crystal. They form incoherent light images which correspond to the input light image O'(x',y')[1,2] after they are corrected by P_2. O'(x',y') is object image in Fourier transformation light path. By adjusting the voltage and frequency on LCLV, a linear relation between O'(x',y') and O(x,y) can be obtained: O'(x',y') = aO(x,y). L_3 is Fourier transformation lens, P is spectrum surface, the spectrum profile is

$$F\{O'(x', y')\} = F\{\alpha O(x, y)\} = \alpha F\{O(x, y)\}$$

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* Numbers in margins indicate foreign pagination. Commas in numbers indicate decimals.

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By introducing record board H on the spectrum surface and reference light, a holograph on aO(x,y) can be recorded.

In order to achieve high quality storage, a careful adjustment of the voltage and frequency on the light valve is needed in order to obtain a linear relation of input and output(in the experiment we chose U = 3.6 V, f = 500 Hz). The spatial relation between light axes of polarizer P_1 and P_2 has great effect on the output and holographic recording. They have to be placed in such a way so that it satisfies the linearity of the input and the output, and achieve a maximum contrast in interference fringes (interference between the reference light and the spectrum profile). The light axis of P_2 is rotated so that it is perpendicular to holographic platform, while P_1 is adjusted to U = 3.6 V, f = 500 HZ in order to obtain an linear output. An additional polarizer P_3 whose light axis is also perpendicular to the holographic platform is added to the reference light beam.

In order to linearly record holographs for both high and low frequency portion of the spectrum, we used out of focus(3) and diluted developing(4). The results are shown in fig.2.

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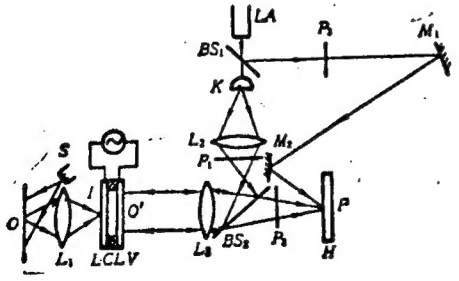

Fig. 1 An experimental setup for recording real-time Fourier transform hologram of data

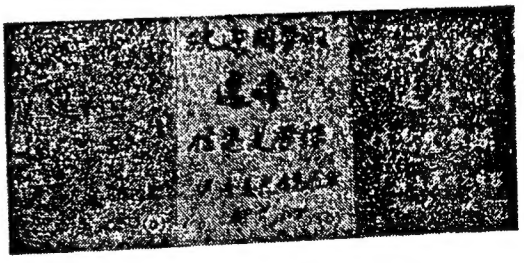

Fig. 2 Experimental results

(*a*) original data; (*b*) reconstructed image of the positive image's hologram; (*c*) reconstructed image of the negative image's hologram

In comparison to ordinary storage, the following are advantages of the results of omission of conversion of data to negative images: saving film; simplifying experimental procedures; real time; convenience in storing both negative and positive images. For data that needs positive image storage(i.e painting), in ordinary storage method, two shootings have to be done in preliminary processing or reverse developing has to be used in order to obtain a positive image. With our method, we can directly get positive image output O'(x',y')=aO(x,y). Even in some special applications in which storage of negative image information is needed, our method is still valid. This is because of the presence of sharp light peaks on electric-optical curve of liquid crystals. When working points are in regions where light intensity is strictly monotonic on the voltage, light valve will have output images with reverse contrast. Thus, by merely changing the voltage U, a reverse output of O(x,y), O''(x'', y''), and O''(x'', y'') = BO(x, y) can be obtained (U=9.8V when all the other variables are kept constant). Of course, by changing polarizer P_1 (fig.1) or the position of light axis of the reverse polarizer, a reverse output of object O(x,y) can be obtained. This is easier to handle and precisely what we did in our experiment. Fig.2(c) is a reconstructed image of the negative image hologram.

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